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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/084,321	02/28/2002	Minh Van Ngo	50432-228	6881

7590 10/10/2003

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Washington, DC 20005-3096

EXAMINER

ROMAN, ANGEL

ART UNIT	PAPER NUMBER
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2812

DATE MAILED: 10/10/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Applicati n No.

10/084,321

Applicant(s)

NGO, MINH VAN

Examiner

Angel Roman

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-15 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1,2,4-8 and 10-15 is/are rejected.
- 7) ☒ Claim(s) 3 and 9 is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 28 February 2002 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on ____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). ____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) ____ 6) ☐ Other: ____

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

3. Claims 1, 2, 4-8 and 10-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Van Ngo et al. in view of Delfino U.S. Patent 4,549,064 A.

Van Ngo et al. discloses a method of manufacturing a semiconductor device, the method comprising; forming a wafer containing inlaid copper (Cu) or a Cu alloy; treating an exposed surface of the Cu or Cu alloy to remove oxide therefrom; and depositing a silicon nitride capping layer on the treated Cu or Cu alloy. 2. The exposed surface of the Cu or Cu alloy is treated with a plasma containing ammonia at a temperature of about 250 °C to about 320 °C to remove copper oxide therefrom (see DETAILED

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DESCRIPTION, paragraph 8). The wafer may contain a dual damascene structure comprising a Cu or Cu alloy line in contact with an underlying Cu or Cu alloy via or contact formed in a dielectric layer; and the dielectric layer comprises a material having a dielectric constant less than about 3.9 (see DETAILED DESCRIPTION, paragraph 10).

Van Ngo et al. is applied as above but lacks anticipation on laser thermal annealing the deposited silicon nitride capping layer to increase its density to a second density greater than a first density in nitrogen at a temperature of about 420-480°C, the first density being increased by about 5-8% to a value of about 2.67-2.77 g/cm³, the laser having a radiant fluence of about 0.114-0.130 joules/cm². Delfino discloses a process for densifying silicon nitride layers by laser thermal annealing in nitrogen with a laser having a radiant fluence of about 0.114-0.130 joules/cm² (see DETAILED DESCRIPTION, paragraph 5). In view of this disclosure it would have been obvious to a person having ordinary skills in the art at the time the invention was made to laser anneal the silicon nitride layer disclosed in the primary reference of Van Ngo et al. using the process disclosed in Delfino to increase the silicon nitride layer density to a desired value since it would improve tensile stress in the semiconductor device (see SUMMARY OF THE INVENTION). Regarding increasing the silicon nitride layer density by 5-8% or a value of 2.67-2.77 g/cm³, Delfino discloses a densifying the silicon nitride layer but does not disclose a particular value for this parameter. However, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to provide a density increase parameter value of 5-8% or a value of 2.67-2.77 g/cm³, since

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it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the "optimum range" involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

Allowable Subject Matter

4. Claims 3 and 9 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

5. The following is a statement of reasons for the indication of allowable subject matter: The prior art of record either singularly or in combination failed to anticipate or render obvious the limitations of depositing the silicon nitride capping layer by plasma enhanced chemical vapor deposition (PECVD) at a temperature of about 250 °C to about 320 °C.

Conclusion

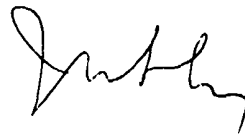
6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Rose discloses a process for laser annealing silicon nitride layers.

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7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Angel Roman whose telephone number is (703) 306-0207. The examiner can normally be reached on Monday-Friday 8:30am-6:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John Niebling can be reached on (703) 308-3325. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-1782.

A handwritten signature in black ink, appearing to read "John Niebling", is positioned to the right of the text block.

AR
29 September 2003